Is a mindfulness program effective on adolescents' psychological well-being in secondary school? A cluster randomized controlled study

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Master's Thesis
Psychology
Faculty of Medicine
February 2019
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Research project: Healthy Learning Mind, Folkhälsan

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Työn nimi – Arbetets titel – Title

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Oppiaine – Läroämne – Subject

Psychology

Työn ohjaaja(t) – Arbetets handledare – Supervisor	Vuosi – År – Year
Salla-Maarit Volanen, Jari Lahti	2019

Tiivistelmä – Abstrakt – Abstract

Objective: Mindfulness-based programs are increasingly used with adolescents in school environment. Many preliminary studies have shown that training mindfulness can be helpful for enhancing students' mental health and psychological well-being. The current evidence base on the effectiveness, however, is still quite narrow and most studies have been limited due to methodological weaknesses. The aim of this study was to investigate how mindfulness training impacts on adolescents' psychological well-being in secondary school.

Methods: The study is a cluster randomized controlled trial, and a part of the Finnish school-based mindfulness research project Healthy Learning Mind (N=3519). Adolescents (age: 12-15 years) either participated in a 9-week mindfulness program, a standardized relaxation program, or followed usual school curriculum. Students' emotional and behavioural problems, and prosocial behaviour were measured at baseline, post-intervention, and after six-month follow-up, using self- and parent-rated Strengths and Difficulties Questionnaire (SDQ). Linear mixed effects modelling (LMM) was used to compare differences between groups in the change from baseline to post-intervention and follow-up in the SDQ-scales.

Results: There weren't any statistically significant differences in change in any SDQ -outcome variables between the three groups at post-intervention or follow-up. However, during mindfulness program, students' self-rated emotional symptoms and hyperactivity problems decreased and prosocial behaviour increased. Findings in the parent-rated results paralleled these results, and students' conduct and emotional problems and hyperactivity were significantly decreased.

Conclusions: Despite positive changes in the psychological well-being of the adolescents in the mindfulness group, no differences between the groups were found. Further research is still required to identify psychological well-being benefits of mindfulness training in school environment, using multiple measurement methods and longitudinal designs.

Avainsanat – Nyckelord – Keywords

Mindfulness, Adolescence, Schools, Education, Mental Health, Well-being, Relaxation

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Tiedekunta – Fakultet – Faculty	Laitos – Institution – Department
Lääketieteellinen tiedekunta	Psykologia

Tekijä – Författare – Author

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Työn nimi – Arbetets titel – Title

Onko tietoisuustaito-ohjelmalla vaikutusta nuorten psykologiseen hyvinvointiin yläasteella? Klusteri satunnaistettu ja kontrolloitu tutkimus

Oppiaine – Läroämne – Subject

Psykologia

Työn ohjaaja(t) – Arbetets handledare – Supervisor	Vuosi – År – Year
Salla-Maarit Volanen, Jari Lahti	2019

Tiivistelmä – Abstrakt – Abstract

Tavoitteet: Tietoisuustaitoharjoittelulla on osoitettu olevan monenlaisia positiivisia vaikutuksia nuorten oppilaiden mielenterveyteen ja psykologiseen hyvinvointiin. Aihealueen tutkimus on kuitenkin vasta alkuvaiheessa ja monissa tutkimuksissa on selkeitä menetelmiin liittyviä rajoituksia. Tämän tutkimuksen tavoitteena oli selvittää, kuinka tietoisuustaitoharjoittelu vaikuttaa nuorten psykologiseen hyvinvointiin toteutettuna osana yläasteen opetusohjelmaa.

Menetelmät: Tutkimus on osa laajempaa Terve Oppiva Mieli -tutkimusprojektia, johon osallistui 3519 oppilasta Etelä-Suomen yläasteilta. Tutkimuksessa käytettiin klusterisatunnaistettua ja kontrolloitua asetelmaa ja nuoret osallistuivat joko 9-viikkoa kestävään tietoisuustaito-interventioon, vakioituun rentoutus-ohjelmaan tai noudattivat tavanomaista opetusohjelmaa. Nuorten psykologista hyvinvointia mitattiin Vahvuudet ja Vaikeudet -kyselyllä (SDQ), jonka nuoret itse ja heidän vanhemmat täyttivät ennen interventiota, heti sen päätyttyä ja kuuden kuukauden seurannan jälkeen. Tulokset analysoitiin käyttäen lineaarista sekamallinnusta vertaillen SDQ-muuttujien muutosta lähtötasolta intervention ja seurannan jälkeisiin tasoihin eri ryhmien välillä sekä jokaisen ryhmän sisällä.

Tulokset: Tilastollisesti merkitseviä ryhmien välisiä eroja ei löytynyt muutoksessa lähtötason ja 9-viikon tai 6-kuukauden seurannan välillä missään mitatussa SDQ-muuttujassa. Kuitenkin interventioryhmässä tietoisuustaitoharjoittelu vähensi tilastollisesti merkittävästi oppilaiden itseraportoimia emotionaalisia hankaluuksia ja hyperaktiivisuutta sekä lisäsi prososiaalista käyttäytymistä. Vanhempien raportoimat tulokset olivat lähes vastaavia kuin oppilaiden raportoimat tulokset, ja nuorten käytösongelmat, emotionaaliset hankaluudet ja hyperaktiivisuus vähenivät tilastollisesti merkittävästi.

Johtopäätökset: Vaikka tietoisuustaitoharjoittelun havaittiin lisäävän psykologista hyvinvointia interventioryhmän sisällä, ei ryhmien välisiä eroja tullut esille**.** Näin ollen lisää laajoja satunnaistettuja ja kontrolloituja tutkimuksia tarvitaan, jotta voitaisiin paremmin ymmärtää, miten tietoisuustaitoharjoittelu todella vaikuttaa nuorten psykologiseen hyvinvointiin kouluympäristössä. Jatkossa tulisi käyttää monia erilaisia mittausmenetelmiä sekä tutkia myös harjoittelun pitkittäisvaikutuksia.

Avainsanat – Nyckelord – Keywords

Tietoisuustaidot, Mindfulness, Nuoruus, Koulu, Opetus, Mielenterveys, Rentoutus

Säilytyspaikka – Förvaringsställe – Where deposited

Helsingin yliopiston kirjasto – Helda / E-thesis (opinnäytteet) *ethesis.helsinki.fi*

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1. Introduction

Adolescence is an intense period of development between childhood and adulthood. It typically describes years from 10 to 19 (World Health Organization, 2005), and refers rapid changes both physically and psychosocially (Berger, 2003, p. 381-461). Adolescence can be a time of new opportunities as independence is increasing, but also a time of confusion. Adolescents must face many developmental changes, societal challenges, and new stressors that can have an impact on their mental well-being and psychological functioning (Berger, 2003, p. 381-461; Christie & Viner, 2005). WHO underlines (2018) that adolescents are particularly vulnerable when their cognitive and psychosocial capacities are still developing and they are beginning to achieve an autonomy from their families. Especially, as most mental health disorders emerge in childhood or adolescence (Kessler et al., 2007; Merikangas, Nakamura & Kessler, 2009), it is important that psychological well-being of young people is societally supported and enhanced.

Nowadays, there is room for new interventions for this purpose, and one promising approach is to provide programs of mindfulness training (e.g. Burke, 2010; Meiklejohn et al., 2012). These programs could offer a unique way to generally enhance adolescents' overall psychological well-being. Mindfulness-based interventions are becoming more and more popular with different populations and are already used increasingly in schools with adolescents (Carsley, Khoury & Heath, 2018). But then again, there are only few studies on the efficacy of mindfulness-based programs in schools and more studies with high quality methods are needed (Volanen et al., 2016). The aim of this study is to explore how a school-based mindfulness curriculum impacts on adolescents' psychological well-being.

1.1. Adolescence and psychological well-being

Adolescence is characterized by many developmental changes (physical, cognitive, emotional development), social changes, and increases in mental health problems (Berger, 2003, p. 381-461; Christie & Viner, 2005; Kessler et al., 2007; Merikangas, Nakamura & Kessler, 2009). The primary physical challenge is puberty that ends childhood and refers a rapid physical growth, brain maturation, and sexual differentiation (Berger 2003, p. 437). Together with brain maturation, adolescents' cognitive skills and executive functions, such as decision-making and abstract thinking capacities, are developing (Christie & Viner, 2005; Giedd, 2008). Psychosocial development also

occurs during adolescence, as individuals try to form their own personal identity, develop coping strategies, and achieve autonomy and independence from their parents (Erikson, 1982; Christie & Viner, 2005; Kinnunen, Laukkanen, Kiviniemi & Kylmä, 2010; Lee & Hotopf, 2005). During the development, these physical, psychological, and social changes can be confusing, and overwhelm adolescents' general functioning and result in psychological symptoms of distress (Meiklejohn et al., 2012). Significant and prolonged stress can be harmful for adolescents and a risk factor for mental disorders and poorer cognitive abilities (Meiklejohn et al., 2012). Also, various societal factors, such as living in a multi-tasking and fast-paced world, may overload adolescents' cognitive capacities, and have negative influence on adolescents' psychological well-being (Salzman & Goldin, 2008; Volanen et al., 2016).

Consequently, adolescence is a sensitive period of development that can have long lasting consequences up to adulthood (Patel, Flisher, Hetrick & McGorry, 2007). Most mental health problems typically begin in adolescence, in a period between aged of 12-24, even though they are often detected later in life (Merikangas, Nakamura & Kessler, 2009; Patel et al., 2007). According to a recent study, almost one in every four adolescents has a lifetime mental disorder, and the prevalence is even higher than the major physical disorders (Merikangas et al., 2010). The most common mental health problems are anxiety disorders, followed by behaviour disorders, mood disorders, and substance use disorders (Merikangas et al., 2010). Anxiety problems can already occur in early childhood, but the risks for other disorders are low until early adolescence (Merikangas et al., 2010). Despite long-lasting consequences of mental disorders in adolescence, less than half of adolescents receive treatment for their current disorders (Merikangas, Nakamura & Kessler, 2009).

The mental health of adolescents can be influenced by many factors, involving biological, psychological, and social factors and causes of problems are usually complex (Patel et al., 2007; WHO, 2005). For example, learning disorders, maladaptive personality traits, and physical and emotional abuses are psychological risks that can expose adolescents to mental health problems (Patel et al., 2007). Different kind of family conflicts, families with parental mental disorder, inconsistent parenting, or death of a family member are major social risk factors in families (Patel et al., 2007). Educational pressures and bullying are social risk factors at school for poor mental health (Patel et al., 2007). In addition to psychological and social aspects, genetic and biological factors, such as genetic tendency to mental-health problems or poor physical health, are also associated to emotional and behavioural disorders (Patel et al., 2007). Most of adolescents, however, do not have any mental disorders, even if they face some risk factors (Patel et al., 2007).

Therefore, protective factors, such as close peer relationships, family connections (Hall-Lande, Eisenberg, Christenson & Neumark-Sztainer, 2007), and adolescents' own abilities to cope with life events and manage stress (Kinnunen et al., 2010; WHO, 2005) are also important to consider, in order for mental health problems to be prevented and psychological well-being enhanced.

To complete, adolescence is an important period of life to implement well-being programs (WHO, 2005). The common focus of these programs should be on prevention or early interventions that can promote adolescents' psychological well-being and reduce risks for mental disorders (Merikangas et al., 2010; Schonert-Reichl, Offer & Howard, 2013; WHO, 2005). Because adolescents spend majority of their days in school, school setting offers an ideal environment for this purpose (Meiklejohn et al., 2012). School-based interventions can also enhance adolescents' academic achievement as well as social well-being by developing peer relationships and relationships with adults (Hall Lande et al., 2007). Arranging group interventions in school setting has additional benefits as school services are accessible and cost-effective compared to clinical services, and they can potentially reduce social comparison and inequality between different subgroups of adolescents as well as the stigma associated with mental problems (Carsley, Khoury & Heath, 2018; Kuyken et al., 2013; Volanen et al., 2016). All these things considered, especially programs of mindfulness training in schools may be promising interventions to support the overall healthy development during adolescence (Maloney, Lawlor, Schonert-Reichl & Whitehead, 2016; Meiklejohn et al., 2012).

1.2. Theoretical background of mindfulness

Mindfulness has a large number of different definitions, but most commonly it is connected to attention and awareness in the present moment. The roots of mindfulness are in ancient Eastern traditions, and it is most commonly associated with Buddhist tradition and meditative practice (Kabat-Zinn, 2003). Historically, the term mindfulness is translation of the Pali word *sati* that means awareness, attention, and remembering (Germer, Siegel & Fulton, 2016, p. 5). Currently, the word mindfulness is used to describe a theoretical construct, different mindfulness practices, or psychological processes (Germer, Siegel & Fulton, 2016, p. 6).

As a construct, mindfulness is described in many ways. For example, it is associated to *awareness* by defining it as "a clear and single-minded awareness of what actually happens to us and in us, at successive moment of perceptions" (Nyanaponika Thera, 1972, p. 5), and "the awareness that

emerges through paying attention on purpose, in the present moment, and nonjudgmentally to the unfolding of experience moment by moment" (Kabat-Zinn, 2003). Mindfulness is also said to be *a state* of consciousness which varies within and between individuals (Brown & Ryan, 2003) and *a process* of attention regulation with an orientation toward one's experiences in the present moment, characterized by curiosity, openness, and acceptance (Bishop et al., 2004). Although the definitions vary, mindfulness can be understood as a basic human ability: kind of metacognitive skill that can be practiced and cultivated through continuous training (Meiklejohn et al., 2012).

The core idea of mindfulness training is attending, observing, and accepting what is happening here-and-now, involving attention to both outer events and inner experience in a purposeful way without judgement or criticism (e.g. Bishop et al., 2004; Meiklejohn et al., 2012). Since there is not only one operational definition of mindfulness, also practices of mindfulness are different in each mindfulness intervention, depending on population to whom the intervention is targeted (Baer, 2003; Kallapiran, Koo, Kirubakaran & Hancock, 2015; Meiklejohn et al., 2012). The most common mindfulness practices include various formal exercises, such as sitting meditation, body scan exercises, yoga poses, and mindful movement, and informal practices where the aim is to bring mindful presence in daily living (Baer, 2003; Kabat-Zinn, 1982).

1.3. Mindfulness-based interventions with adults

There are many different mindfulness-based interventions (MBIs) with adults that are adaptable to a range of mental disorders and psychological conditions (Baer, 2003). Despite the origins of mindfulness, in health care and education, it is taught in a secular way without any cultural issues or philosophy (Keng, Smoski & Robins, 2011). It was not until the late 1970s that mindfulness was studied in health care as an intervention to enhance psychological well-being (Keng, Smoski & Robins, 2011). The first behavioural MBI, *mindfulness based stress reduction (MBSR)*, was developed to treat patients with chronic pain and stress-related disorders (Kabat-Zinn, 1982, 1990). It was also developed to be "a training vehicle for the relief of suffering", and a tool through which individual could take a degree of responsibility for his/her own well-being (Kabat-Zinn, 2003).

As an intervention, MBSR is an 8- or 10-week group program which offers mindfulness training to help individuals with their physical and psychological conditions (Kabat-Zinn, 1982, 1990). The program consists of a group up to 30 participants who meet for two hours each week to practice skills of mindfulness meditation and to discuss various topics such as stress and coping. In addition

to group-exercises, participants are encouraged to continue practices daily at home. Several formal mindfulness practices are taught in MBSR, such as sitting meditation, body scan exercises and yoga poses. Mindfulness is also taught using informal activities, such as walking and eating, to help to develop an ability to bring mindfulness in daily living.

In a common formal mindfulness meditation training, participants are instructed to bring attention to the object of observation (e.g. breathing) and to be aware of it during an exercise (Kabat-Zinn, 1982). When participant notices that the mind has wandered, the attention is brought back to the present moment. If strong feelings, body sensations, or thoughts arise, attention is directed to them and they are observed nonjudgmentally. Participants are also instructed to observe all thoughts as equal value and as temporal events of mind. However, it is important to keep in mind that mindfulness training is not only "a mechanical self-repetition of these meditation instructions, but a commitment to reside as best one can from moment to moment in awareness with an open heart, a spacious, nonjudging, nonreactive mind, and without trying to get anywhere, achieve anything, reject anything, or fall in either the stream of conceptual thought or emotion" (Kabat-Zinn, 2003).

Along with MBSR, most popular adults' interventions, based on mindfulness training, are *mindfulness-based cognitive therapy* (MBCT, Segal, Williams & Teasdale, 2002), *dialectic behavioural therapy* (DBT, Linehan, 1993), and *acceptance and commitment therapy* (ACT, Hayes, Strosahl & Wilson, 1999). These four interventions are typically considered as a family of "mindfulness-oriented interventions" in adults and have the most empirical interest (Keng, Smoski & Robins, 2011). In these interventions, there are some variations on how mindfulness is taught, but all use similar mindfulness-related practices and principles (Keng, Smoski & Robins, 2011).

Generally, these different MBIs are increasingly popular with adults, and the current research suggests them to be helpful in a treatment of several mental health problems (Baer, 2003). For instance, research with adults shows that mindfulness training decreases symptoms of anxiety and depression (Hofmann, Sawyer, Witt & Oh, 2010; Teasdale et al., 2000) and increases mental well-being of adults with different chronic somatic diseases, such as cancer (Bohlmeijer, Prenger, Taal & Cuijpers, 2010; Smith, Richardson, Hoffman & Pilkington, 2005). MBIs are also potential interventions in treating some medical or somatic conditions, such as attention deficit hyperactivity disorder (ADHD) (Smalley et al., 2009; Zylowska et al., 2008), chronic pain (Kabat-Zinn, 1982; Kabat-Zinn, Lipworth, Burney & Sellers, 1987), and fibromyalgia (Astin et al., 2003). In addition to clinically significant benefits, mindfulness training has several positive psychological well-being effects on adults, such as increased subjective well-being, improved behavioural regulation, and reduced psychological symptoms, emotional reactivity, and perceived stress (Keng, Smoski &

Robins, 2011). Mindfulness training may also be helpful to completely non-clinical sub-groups of adults, e.g. to school teachers, by decreasing stress and symptoms of burnout as well as by helping adults to develop better self-regulatory resources (Jennings et al., 2013; Roeser et al., 2013).

The active elements, through which mindfulness training with adults may influence psychological well-being, are initially suggested to include e.g. attentional control, emotion and behaviour regulation, acceptance/self-compassion, mindful awareness, and mechanisms of worry and rumination (Gu, Strauss, Bond & Cavanagh, 2015; Keng, Smoski & Robins, 2011). However, the mechanisms behind effects of MBIs on psychological well-being are complex to investigate, and further research is still needed (Gu et al., 2015).

1.4. Mindfulness with adolescents

Based on popularity of MBIs with adults, interest has spread to mindfulness-based approaches with children and adolescents (Burke, 2010; Felver, Celis-de Hoyos, Tezanos & Singh, 2016; Meiklejohn et al., 2012). Nowadays, many mindfulness programs have been adapted for young people around the world, especially to meet developmental needs of different age groups and different populations (Carsley, Khoury & Heath, 2018; Kallapiran et al., 2015; Meiklejohn et al., 2012). The programs are typically adapted from adults' interventions, especially from MBSR or MBCT, to be appropriate for younger populations with much shorter and playful practices (Carsley, Khoury & Heath, 2018; Zoogman, Goldberg, Hoyt & Miller, 2015). MBIs are increasingly used to treat different mental disorders with children and adolescents in clinical context, and to support and enhance their psychological well-being in school environment (Carsley, Khoury & Heath, 2018; Kallapiran et al., 2015). Especially, there has been a growth of research of MBIs in school settings (Carsley, Khoury & Heath, 2018).

In schools, mindfulness is taught in a practical way through different age-appropriated mindfulness practices and applications in everyday life (Meiklejohn et al., 2012). The main intention of MBIs in school setting is to help students to work with their mental states and stressors in everyday life in ways that may promote their mental health and well-being (Meiklejohn et al., 2012). By training mindfulness, adolescents can relate to their internal experiences and outer events with an attitude of acceptance and in ways that are "responsive, present-centred, and objective" (Meiklejohn et al., 2012). Both formal and informal mindfulness exercises may strengthen the adolescents' ability to be mindfully present here-and-now, and therefore increasing their capacities to relate in a responsive way to different experiences (Meiklejohn et al., 2012).

When individual can face emotional or stressful situations with focus on the current experience, especially skills of self-regulation are strengthened (Bishop et al., 2004). Practicing mindfulness in schools may support emotion and behavioural regulation by developing students' abilities to be aware of and express emotions in adaptive ways, by modifying duration and intensity of emotion-related arousal, and by decreasing impulsive behavioural reactions (Broderick & Jennings, 2012; Meiklejohn et al., 2012). For example, when students are becoming more aware of automatic behavioural processes, maladaptive behavioural reactions are more easily controlled, when facing uncomfortable situations (Broderick & Jennings, 2012). Thus, mindfulness training may be beneficial even with adolescents who have severe classroom problem behaviour by enhancing students' self-regulation strategies (Singh et al., 2007).

Regular mindfulness training can also strengthen students' executive functions and cognitive skills, such as self-control and attention, through repeated "focusing, sustaining, and shifting of attention" (Meiklejohn et al., 2012). These skills are an essential part of adolescents' development, well-being, and academic abilities (Flook et al., 2010), and their impairments are associated, e.g. with poor academic function and behavioural and emotional difficulties (Biederman et al., 2004; Blair, 2002; Brocki & Bohlin, 2006). Training attention may have extra benefits for the whole learning environment, including school personnel, when students can focus more fully on learning (Black & Fernando, 2014). Also training kindness towards oneself may lead to greater kindness and empathy towards others (Baer, 2003), and consequently improve students' peer relationships and social well-being which are central parts of overall psychological well-being.

Altogether, mindfulness training already in adolescence may promote many possible benefits but it is not the cure for every psychological or mental problem (Rechtschaffen, 2014, p. 5). Instead, it invites individuals to bring awareness inside: to own mind, body sensations and emotions, and to be open to what is true in this moment (Rechtschaffen, 2014, p. 5).

1.5. Current research with adolescents

Several studies and some meta-analyses have been conducted to examine effects of MBIs on adolescents' mental health and well-being. MBIs for students are feasible, acceptable, and potentially beneficial to enhance their psychological well-being as a part of education (Carsley, Khoury & Heath, 2018; Felver et al., 2016; Meiklejohn et al., 2012). Both uncontrolled and randomized controlled trials (RCT) on effectiveness of mindfulness training have shown improvements in behaviour, cognitive function, emotional symptoms, and social outcomes

(Carsley, Khoury & Heath, 2018; Burke, 2010; Kallapiran et al., 2015; Meiklejohn et al., 2012). While MBIs are currently brought very actively into education, the overall research base about their efficacy is still quite small and many studies are limited due to methodological weaknesses (Johnson, Burke, Brinkman & Wade, 2017).

1.5.1. Meta-analyses

A few meta-analyses have already shown that mindfulness training has a significant positive effect on adolescents' psychological well-being (Carsley, Khoury & Heath, 2018; Kallapiran et al., 2015; Zenner, Herrnlebe-Kurz & Walach, 2014; Zoogman et al., 2015). For instance, in a recent meta-analysis, Kallapiran and colleagues (2015) found that MBIs reduce children and adolescents' stress, anxiety, and depressive symptoms, and increase quality of life both in clinical and school environment. The meta-analysis included 11 RCTs with both non-clinical and clinical population, and the results of MBIs were comparable to active interventions and better than nonactive controls in most studies (Kallapiran et al., 2015).

Yet, mindfulness training may be more effective for clinical population, impacting stronger on symptoms of psychopathology than positive functioning (Zoogman et al., 2015). Zoogman and colleagues' (2015) meta-analysis included 20 studies with youth (age range 6-21) compared to active interventions. The analysis reported an overall small effect sizes over a range of well-being outcome variables but moderate effect sizes in clinical samples. The effect sizes were larger for psychological symptoms, as compared with physiological and cognitive variables. It should be noted, however, that these two meta-analyses did not focus only on studies of mindfulness training in school settings. There were also other limitations as the age range of participants was large, the heterogeneity of mindfulness programs was remarkable, and the number of included studies were small of which many also had weak quality (Kallapiran et al., 2015; Zoogman et al., 2015).

Focusing only on MBIs in schools, a recent meta-analysis (k=24) indicate MBIs to be effective for students' mental well-being with small to moderate significant effects that are smaller when compared with clinical or healthy sample of adults (Carsley, Khoury & Heath, 2018). According to the results, students' age and a program content have an influence on the effectiveness, and effects on mental well-being are larger when MBIs contain several different practices and are delivered during late adolescence (age: 15-18). Likewise, Zenner and colleagues' (2014) meta-analysis, focusing on MBIs in schools for students' psychological well-being (cognitive performance, stress, coping, resilience and emotional problems), revealed a significant medium overall effect size. The

analysis included 24 studies of which 19 had controlled designs. The effect sizes varied across the mental well-being domains, by being large for cognitive measures but non-significant for emotional problems. In this analysis as well as Carsley et al.'s (2018) analysis, the heterogeneity of studies was large which at some level limits the generalization of the results. It is also still unknown, how effects of mindfulness training differ from other similar well-being programs, and more studies with active control groups are needed (Carsley, Khoury & Heath, 2018). Yet, mindfulness training in school setting has potentially some added value for students' psychological well-being although the effects may differ due to students' baseline symptomology, developmental period, and measured mental well-being domains.

1.5.2. Studies in clinical settings

In clinical setting, different MBIs have been adapted for several subpopulations, and preliminarily they are promising interventions for adolescents to treat various mental disorders (Zoogman et al., 2015). One clinical RCT (N=108) suggests that mindfulness training has positive effects on adolescents' self-reported psychological well-being as well as their clinically significant mental health problems (Biegel, Brown, Shapiro & Schubert, 2009). The study discovered various well-being benefits and showed that mindfulness training is effective to improve depression, anxiety, perceived stress, obsessive symptoms, and interpersonal problems compered to active control group (treatment as usual). The results suggest that MBIs may be promising treatments already in an early age for a range of mental health problems (Biegel et al., 2009).

In addition to these findings, many pilot studies in clinical settings have shown mindfulness to be a helpful approach for adolescents with specific mental health disorders. For instance, a small clinical pilot study (N=11) indicates that mindfulness training may be useful especially for adolescents with low mood (Ames, Richardson, Payne, Smith & Leigh, 2014). According to the results, mindfulness training was feasible and acceptable among adolescents who had received treatment for mood disorders, and they reported high satisfaction for the group intervention. The results also indicated reductions in depressive symptoms and rumination, and improvements in mindfulness skills and quality of life.

Different MBIs have also improved many behavioural and neurocognitive impairments of attention and hyperactivity problems, and at the same time improved participants' emotional symptoms, awareness, and social well-being (Bögels, Hoogstad, van Dun, de Schutter & Restifo, 2008; van der Oord, Bögels & Peijnenburg, 2012; van de Weijer-Bergsma, Forsma, de Bruin & Bögels, 2012).

For instance, in Bögels et al.'s study (2008), children (N=14) who participated in an 8-week mindfulness program, performed better on a sustained attention test compared to individuals on a waitlist. Also, both children and their parents reported improvements in behavioural and attention problems (Bögels et al., 2008). Findings have been parallel in other small pilot studies that have found improvements in inattention, behavioural problems, and executive functioning (van der Oord, Bögels & Peijnenburg, 2012; van de Weijer-Bergsma et al., 2012). These pilot results, however, should be interpreted keeping in mind their methodological limitations, including small sample sizes, non-randomized designs, lack of active-control conditions, and/or lack of follow-ups. Yet, MBIs were acceptable in all these studies among diverse clinical subpopulations which indicate that MBIs can be used in school setting even if some students have clinically referred mental health problem(s).

1.5.3. Studies in school settings

In addition to clinical trials, many non-controlled and controlled studies have been conducted in school environment. According to non-controlled results, mindfulness training may enhance students' socio-emotional competencies and psychological well-being. For instance, in a large field trial (N=409), mindfulness training was associated with several teacher-reported behavioural and psychosocial improvements, including paying attention, calmness, self-control, participation in activities, and respect for others that lasted up to 7-weeks after the intervention (Black & Fernando, 2014). The results indicate that school-based mindfulness programs may be beneficial for students' well-being in several ways and potentially useful also for the whole learning environment (Black & Fernando, 2014).

Similarly, a non-controlled study by Joyce et al. (2010) suggests that children (N=175, aged 10-13) can easily learn different mindfulness practices and they are able to bring skills of mindfulness to daily living (Joyce, Etty-Leal, Zazryn & Hamilton, 2010). According to their findings, mindfulness training was associated with self-rated emotional well-being improvements for all participants, but the effect was strongest with those children who had notable mental health symptoms at pre-program (Joyce et al., 2010). However, the study did not find any changes in children's prosocial behaviour and more research is still needed to explore how mindfulness training impacts on social behaviour and peer relationships in school settings.

Many controlled studies among children and adolescents have also shown positive results that training mindfulness in schools can be helpful for students' mental well-being and psychological

functioning. At first, large studies have found MBIs to be useful especially for adolescents' emotional well-being by preventing and decreasing symptoms of depression (Raes, Griffith, Van der Gucht & Williams, 2014) and reducing negative impacts of stress and trauma experiences (Sibinga, Webb, Ghazarian & Ellen, 2016). More precisely, Raes et al.'s (2014) RCT included students from five schools (N=408, aged 13-20), and showed significantly greater reduction in depression symptoms in a mindfulness group at 6-month follow-up, yet compared to only a non-active-control group. Sibinga et al.'s (2016) school-based RCT (N=300), with an active control group, showed similarly improvements in psychological symptoms, including depressive symptoms, negative mood, self-hostility, and negative coping approaches. However, the sample consisted of boys only and the results are not generalized to both genders.

Consistent with these findings, a non-randomized controlled feasibility study by Kuyken et al. (2013) have provided evidence that a school-based mindfulness curriculum (N = 522) reduces students' (aged 12-15) self-reported depressive symptoms and stress and enhances their overall well-being when compared to a group of students' who followed usual curriculum. Also, the greater amount of mindfulness training was associated with better well-being improvements. The replication studies of Kuyken et al.'s (2013) study, in turn, showed no differences in psychological well-being outcomes: anxiety, depression, well-being, or mindfulness at post-intervention or follow-up between mindfulness and control groups (Johnson, Burke, Brinkman & Wade, 2016; Johnson et al., 2017). These contrary results highlight the importance of replication findings, especially independent from program developers (Johnson et al., 2017), before general conclusions about the effects of mindfulness training on students' psychological well-being can be made.

In addition to these large trials, many other controlled studies have suggested MBIs to have several other benefits for adolescents' development. One school-based cluster RCT, consisting of girls only (N=347), found out significant reductions in symptoms of eating disorders and psychosocial problems at six-month follow-up compared to a control group (Atkinson & Wade, 2015). A small RCT (N=99) by Schonert-Reichl and colleagues (2015) showed that mindfulness training improves students' self-control and socioemotional well-being by enhancing optimism, empathy, and prosocial behaviour and by decreasing symptoms of depression, stress, and aggression. Regarding on students' cognitive skills and behaviour, small RCTs have revealed improvements in selective attention and test anxiety (N=194; Napoli, Krech & Holley, 2005), and overall executive functions, behavioural regulation, and metacognition (N=64; Flook et al., 2010). However, contrary results in elementary school (N=101) have also indicated that all well-being benefits for cognition, behaviour,

and emotion are not unique for mindfulness training but shared also with other activities such as curriculum on African history (Britton et al., 2014).

1.5.4. Summary

In summary, integrating mindfulness training into education may be a beneficial approach to increase students' psychological well-being in secondary school. Overall results have demonstrated that MBIs for adolescents are feasible, acceptable, and have no adverse effects. Studies have shown that MBIs in schools can support adolescents' emotional regulation and increase their socio-emotional well-being. The programs may have a positive impact on overall classroom environment by enhancing adolescent's behavioural regulation and attention, and by reducing problem behaviour. MBIs in schools may also be beneficial for adolescents with clinically referred attentional, behavioural, and emotional disorders. Therefore, mindfulness can be taught to an entire classroom, despite of specific clinical subpopulations.

Even though findings have been promising, the role of mindfulness in improving adolescents' psychological well-being needs further research, as most studies in school settings have been limited due to methodological weaknesses, such as small sample sizes (e.g. Flook et al., 2010; Schonert-Reichl et al., 2015), unstandardized mindfulness programs (e.g. Atkinson & Wade, 2015; Sibinga et al., 2016), and lack of control groups (Black & Fernando, 2014; Joyce et al., 2010) or active control groups (e.g. Kuyken et al., 2013; Napoli, Krech & Holley, 2005; Raes et al., 2014). This study, as a part of the Finnish research project *Healthy Learning Mind* (Volanen et al., 2016), overcomes these methodological shortcomings by using large scale RCT design with active and non-active control groups, and a standardized mindfulness program. This allows to identify the effects more precisely, adding important and valuable knowledge to the existing research field.

1.6. Research questions and hypotheses

The aim of the present study is to investigate how mindfulness training impacts on adolescents' subjective and observed psychological well-being in secondary school compared to a standardized relaxation-program or a non-treatment group.

Research questions for the study are: (1) Can a 9-week universal school-based mindfulness intervention reduce adolescents' emotional and behavioural problems, and improve their prosocial

behaviour, when measured at post-intervention and six-month follow-up? and (2) Are the effects larger when compared to a standardized relaxation program or to a non-treatment control group?

Firstly, I hypothesized that 9-week mindfulness training will reduce adolescents' emotional and behavioural problems, but due to inconsistent findings of previous research, I made no specific hypothesis on intervention effects on adolescents' prosocial behaviour. Secondly, I expected that the effects are shared with the relaxation program, and they are greater when compared to the non-treatment condition.

2. Methods

2.1. Trial design and participants

The study is a cluster randomized controlled trial and a part of the Finnish school-based mindfulness research project Healthy Learning Mind (Volanen et al., 2016). The project was conducted between the spring of 2014 and the autumn of 2016 in 56 schools, containing 209 classes and 3519 adolescents who participated to the project. The schools were randomized to a mindfulness intervention, a relaxation-control intervention, and a non-treatment group, and the classes (grades 6, 7, and 8) were clusters. The age range was from 12 to 15 years old. The background information of the students, including grade, gender, mother tongue, and participation in special needs education, was collected at baseline.

2.2. Measure

Students' emotional and behavioural problems, prosocial behaviour, and overall psychological well-being were measured by using *the Strengths and Difficulties Questionnaire* (SDQ) (Goodman, 1997). The measure is a brief screening questionnaire for mental health problems of children and adolescents from age 3 to 16 years (Goodman, 2001). Finnish SDQ has also showed good psychometric properties (Koskelainen, Sourander & Kaljonen, 2000).

The SDQ includes 25 items which are divided into 5 scales of 5 items each: *the emotional symptoms scale, conduct problems scale, hyperactivity scale, peer problems scale, and prosocial scale.* Every item has three different options to answer: "not true", "somewhat true", or "certainly true", which are scored from 0 (not true) to 2 (certainly true). Five items are scored in the opposite

way because they are worded positively. Scores of each five scales are created by summing points of each five items, and they range from 0 to 10 (Appendix 1). *A total difficulties scale* is generated by summing up all the scales except for the prosocial behaviour (Goodman, 1997).

All participants and their parents in each trial arm completed a self-rated or an informant-rated version of the SDQ (Goodman, 1997; Goodman, Meltzer & Bayley, 1998). The self-report version differed from the informant-rated SDQ only by having items in a first person compared to third person format (Goodman, Meltzer & Bayley, 1998). Internal consistencies (Cronbach's α) of the SDQ-scales varied between 0.52 and 0.80 when measured at baseline, post-intervention, and 6-month follow-up (Table 2).

Table 1. Internal consistencies (Cronbach's α) for the SDQ-scales rated by students and their parents.

SDQ-scale	Student			Parent		
	T1 (n)	T2 (n)	T3 (n)	T1 (n)	T2 (n)	T3 (n)
Total difficulties	0.80 (2355)	0.84 (2190)	0.84 (1995)	0.79 (1967)	0.79 (1665)	0.79 (1215)
Emotional symptoms	0.70 (2617)	0.74 (2466)	0.75 (2182)	0.65 (2074)	0.68 (1741)	0.67 (1275)
Conduct problems	0.52 (2596)	0.60 (2465)	0.60 (2162)	0.54 (2072)	0.52 (1751)	0.54 (1271)
Hyperactivity	0.68 (2623)	0.68 (2460)	0.69 (2187)	0.73 (2060)	0.72 (1744)	0.73 (1268)
Peer problems	0.62 (2599)	0.62 (2438)	0.65 (2161)	0.64 (2053)	0.63 (1725)	0.63 (1255)
Prosocial behavior	0.66 (2648)	0.72 (2484)	0.72 (2182)	0.68 (2059)	0.69 (1734)	0.68 (1262)

Note. Total N=3519, T1=Baseline, T2=Post-intervention, T3=6-months follow-up.

2.3. Study procedure and randomization

Participating schools were randomly chosen. The recruitment procedure started by listing all upper comprehensive schools from Southern part of Finland. Next, the head masters from 247 schools were contacted via e-mail and within few days via calling. Altogether, 56 schools (24 %) from 14 cities participated to the study. Randomization between the intervention and the control groups was conducted using available background information, including a teaching language, grade, location, number of classes participating in the study, and an average apartment price per square meter near to the school. More precisely, the schools were first divided into three groups based on the location and the average apartment price. After that, each group was divided into three subgroups each including the same number of classes based on the other background variables.

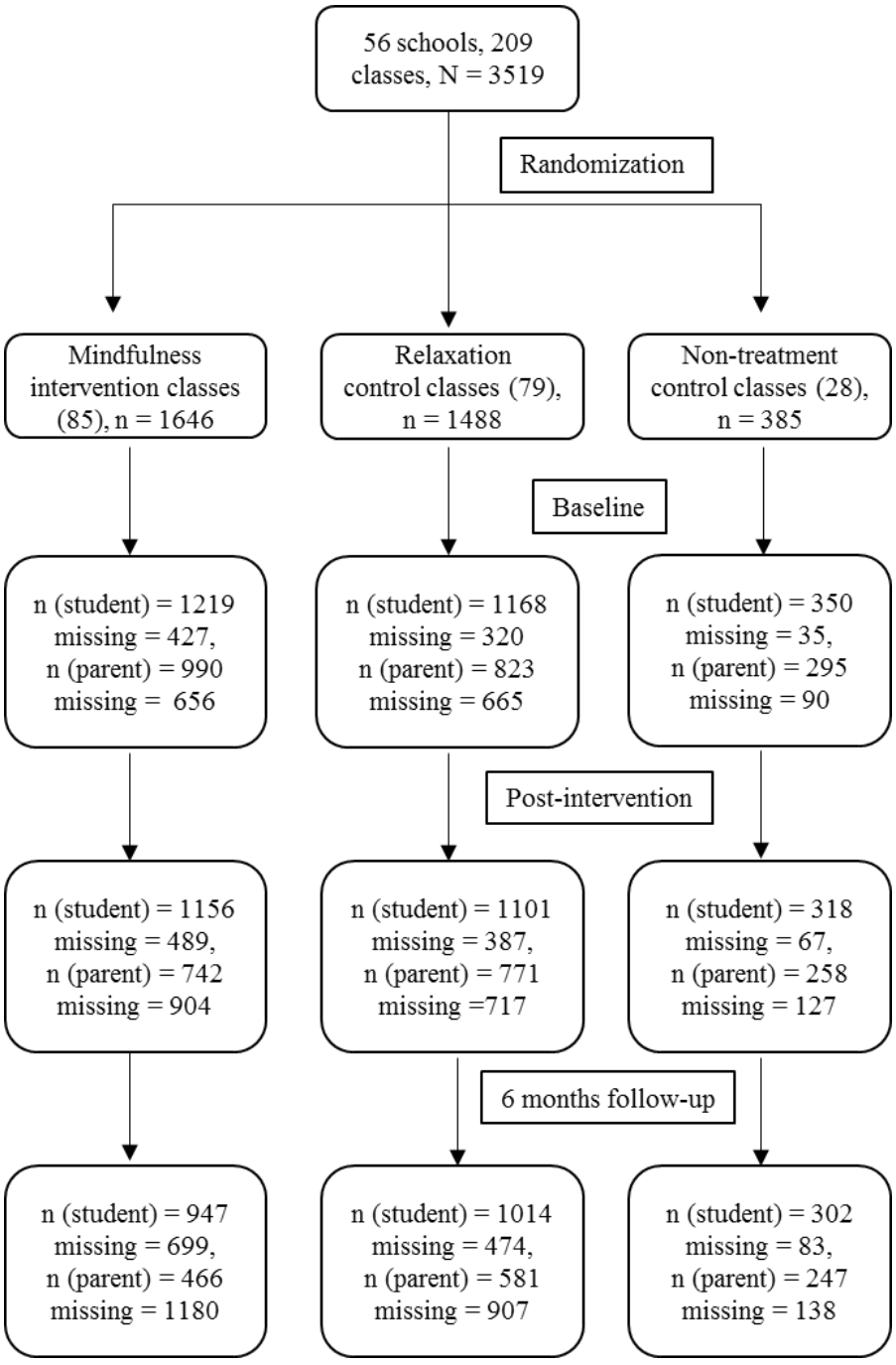

Figure 1. The study procedure and missing information (based on SDQ total difficulties-scales)

Lastly, the school classes were randomized to the mindfulness intervention (n = 85), the relaxation control intervention (n = 79), and the non-treatment control group (n = 28). The data from the mindfulness group and the relaxation group were collected during four academic terms: spring 2014 (n = 523), autumn 2014 (n = 1090), spring 2015 (n =821) and spring 2016 (n =203), and the data from the non-treatment group during two academic terms: spring 2015 (n= 254) and 2016 (n = 109). In all the groups among students and parents, psychological well-being was measured at the

baseline (in the beginning of the term), after 9-week interventions, and after 6-month follow-up from the baseline. The informant-rated data was collected from the same parent (mother or father). Volanen and colleagues (2016) have provided a more comprehensive description of the overall research procedure in their work.

All participants with available data, at least from one measurement point, were included in the analyses. The study procedure and missing information on different measurement points are displayed in Figure 1 where the rates of missing information are based on SDQ total-difficulties scales. The rates can differ a little between other SDQ-subscales. After the follow-up, 15 % of the students (N=528) and 32.5 % of the parents (N=1143) did not answer to the questionnaires at any measurement point and their information was coded missing. Other participants did respond at least at one time during the study, and they were included in the analyses. The final sample consisted of 2991 students and 2376 parents, of which there was complete data for 1916 of participating students (54 % of the total sample) and 981 of their parents (28 % of the total sample).

Differences in the rates of missing information were examined by groups, gender, grades, mother tongue, and special needs education. Difference statistics between students and their parents, who participated and did not participate to the study, are displayed in Table 2. In the data rated by students, there wasn't significant gender difference ($p=.09$), but by trial arms, grades, and special educational needs, differences were on a statistically significant level ($p\leq.001$). More information was missing from the mindfulness group, the relaxation group, and 7th graders. In the parent-rated data, there weren't any differences by grade ($p=.15$) or special needs education ($p=.17$). However, more information was missing from boys, non-native students (mother tongue other than Finnish or Swedish), and mindfulness and relaxation groups ($p<.001$).

Table 2. Background variables of the study sample and the missing sample, and difference statistics (χ^2-tests) between the samples for student- and parent-rated data.

Background variable		Student-rated data				Parent-rated data			
		Study sample	Missing sample	Difference statistics		Study sample	Missing sample	Difference statistics	
		n (%)	n (%)	χ2 (df)	p	n (%)	n (%)	χ2 (df)	p
Gender				2.91 (1)	.09			16.80 (1)	<.001
	Girl	1511 (50.6)	239 (46.5)			1243 (52.4)	507 (44.9)		
	Boy	1477 (49.4)	275 (53.5)			1131 (47.6)	621 (55.1)		
Grade				29.97 (2)	<.001			3.85 (2)	0.15
	6	1099 (36.7)	183 (34.7)			886 (37.3)	396 (34.6)		
	7	539 (18.0)	148 (28.0)			445 (18.7)	242 (21.2)		
	8	1353 (45.2)	197 (37.3)			1045 (44.0)	505 (44.2)		
Mother tongue				-				58.52 (2)	<.001
	Finnish	2230 (80.6)	3 (50.0)			1825 (81.5)	408 (76.3)		
	Swedish	280 (10.1)	0 (0.0)			247 (11.0)	33 (6.2)		
	Other	258 (9.3)	3 (50.0)			167 (7.5)	94 (17.6)		
Special needs education				11.66 (1)	.001			1.90 (1)	0.17
	Yes	160 (5.3)	10 (1.9)			123 (5.2)	47 (4.1)		
	No	2831 (94.7)	518 (98.1)			2253 (94.8)	1096 (95.9)		
Trial arm				60.87 (2)	<.001			87.38 (2)	<.001
	Mindfulness	1333 (44.6)	313 (59.3)			1067 (44.9)	579 (50.7)		
	Relaxation	1288 (43.1)	200 (37.9)			968 (40.7)	520 (45.5)		
	Non-treatment	370 (12.4)	15 (2.8)			341 (14.4)	44 (3.8)		

Note. Total N = 3519, missing n: gender = 17; mother tongue = 745,
-difference testing is not appropriate as cells have expected counts less than 5.

2.4. Mindfulness intervention

Students in the mindfulness group participated in a standardized 9-week school-based mindfulness program, *the MiSP Curriculum .b* (Dot be), which is the UK's leading mindfulness intervention for 11-18-year-old students (Huppert & Johnson, 2010). The program is adapted from MBSR (Kabat-Zinn, 1982) to school curriculum including a range of age-appropriate teaching methods, shortening and adapting mindfulness exercises for adolescents, and practices to bring mindfulness in daily life (Kuyken et al., 2013). The curriculum is designed to improve attention, emotional awareness, emotional regulation, and behavioural regulation (Kuyken et al., 2013; Volanen et al., 2016). It consists of nine 45-min group sessions (one per week) and home practices. Each session is crafted to teach a distinct mindfulness skill (Table 3). Sessions were conducted by 9 educated facilitators

who had attended an 8-week MBSR-course, educated in delivering the .b Curriculum, and practicing mindfulness in their own lives (Volanen et al., 2016).

Table 3. Short overview of each lessons of the .b Curriculum (Mindfulness in Schools Project, 2019).

. b Curriculum
1. Lesson - Introduction: *Mindfulness is introduced in a lively and inspiring way.*
2. Lesson - Puppy training: *Introduces what attention means to students and different mind states are explored together.*
3. Lesson - Taming the Mind: *Teaches how to calm down by anchoring the mind in the body, along with the cultivation of curiosity and kindness.*
4. Lesson - Recognizing Worry: *Explains the nature of how mind leads us to worry and teaches techniques to deal with stress and anxiety.*
5. Lesson - Being Here Now: *How to be present and respond instead of reacting in every life situations are learned as well as how to be enjoying pleasurable experiences.*
6. Lesson - Moving Mindfully*: Mindful movement and a skill to be present during everyday activities are practiced.*
7. Lesson - Stepping Back: *Teaches a new way of relating to our thoughts: students learn to recognize thoughts and deal them more like objects.*
8. Lesson - Befriending the Difficult: *Difficult emotions and stress are dealt so that they can be understood, recognised, and confronted wisely.*
9. Lesson - Pulling It Altogether: *The key mindfulness practices are repeated and students are inspired to use techniques in the future*

2.5. Relaxation and non-treatment control groups

The active-control intervention was a standardized relaxation program called *Relax* developed in co-operation with Folkhälsän Förbundet (Volanen et al., 2016). Like the mindfulness intervention, the program was 9-week intervention consisting of nine 45-min group sessions and home practices.

Every group-session contained relaxation practices and group discussion about different topics (e.g. stress, relaxation, upsides and downsides of smartphones, sleep, exercising, food, and attitudes). The relaxation exercises included progressive muscle relaxation, breathing exercises, visualization, choosing your emotion for rest of the day, and short break for regaining energy. Main goals of the program were to develop students' relaxation skills and enhance their overall well-being.

The non-treatment group did not receive any intervention during the data-collection but had a short well-being course after the one-year follow-up. Participants in the non-treatment group and in the relaxation control group and their parents filled-in the research questionnaire during the same time periods as participants of the mindfulness intervention.

2.6. Statistical analyses

All data analyses were conducted using IBM SPSS Statistics, version 25. Visual inspection of the variable distributions indicated all SDQ outcome scales to be slightly skewed, but the skewness remained moderate (|skewness|=0.47-1.11), and therefore the variables were not transformed. The baseline differences between the three groups were analysed using multivariate analysis of variance (MANOVA) for each SDQ-outcome variable, separately for student- and parent-rated data. The intervention effects were analysed using linear mixed effects modelling (LMM) which handle better unbalanced designs, missing data, hierarchical data, and data gathered at multiple timepoints compared to general linear models (Field, 2013). In the analyses, treatment groups (mindfulness, relaxation, and non-treatment) and time (baseline, post-intervention, and follow-up) were treated as fixed effects, resulting in two main-effects and one interaction-effect for each SDQ-outcome variable with random effects accounting for both individual and school class -level variations. Gender and grade were controlled for in the analyses. Considering the repeated measure design, first-order autoregressive, unstructured, and compound symmetry covariance matrixes were tested as choice of the residual error covariance and selected based on Schwarz's Bayesian Criterion (BIC). Pairwise comparisons between and within groups were conducted using Bonferroni adjustment.

3. Results

3.1. Sample characteristics and baseline data

Table 4 summarizes background variables for the total sample and by trial arms, and the significance of group differences. The age range varied from 12 to 15, and 50.6 % were girls. Most of the students had Finnish as a mother tongue and attended 6th or 8th grade. Only 5.3 % took part in special needs education. The study did not reach every parent of the participating students, and the background variables and difference statistics for the parent-rated data is displayed separately in Appendix 2.

Table 4.Frequencies of background variables for the total sample and by trial arms, and the significance of group differences.

Background variable		Total	Mindfulness	Relaxation	Non-treatment	p_a	p_b	p_c
		n (%)	n (%)	n (%)	n (%)			
Gender						.23	.66	.72
	Girl	1511 (50.6 %)	658 (49.4 %)	666 (51.7 %)	187 (50.7 %)			
	Boy	1477 (49.4 %)	674 (50.6 %)	621 (48.3 %)	182 (49.3 %)			
Grade						0.08	<.001	<.001
	6	1099 (36.7 %)	523 (39.2 %)	462 (35.9 %)	114 (30.8 %)			
	7	539 (18 %)	177 (13.3 %)	205 (15.9 %)	157 (42.4 %)			
	8	1353 (45.2 %)	633 (47.5 %)	621 (48.2 %)	99 (26.8 %)			
Mother tongue						<.01	<.001	<.001
	Finnish	2230 (80.6 %)	965 (78.8 %)	937 (78.7 %)	328 (92.9 %)			
	Swedish	280 (10.1 %)	160 (13.1 %)	119 (10.0 %)	1 (0.3 %)			
	Other	258 (9.3 %)	100 (8.2 %)	134 (11.3 %)	24 (6.8 %)			
Special needs education						<.001	.08	.41
	Yes	160 (5.3 %)	96 (7.2 %)	47 (3.6 %)	17 (4.6 %)			
	No	2831 (94.7 %)	1237 (92.8 %)	1241 (96.4 %)	353 (95.4 %)			

Note. Total N = 2991, missing information: gender = 3, mother tongue = 223; p-values obtained from $\chi 2$-test: p_a = Mindfulness versus Relaxation, p_b = Mindfulness versus Non-treatment, p_c = Relaxation versus Non-treatment.

There weren't any gender differences between the three groups ($p>.05$), but the groups differed from each other by mother tongue ($p<.01$). There were more Finnish speaking students in the non-treatment group, when compared with two other groups. By grades, differences between the non-treatment group and the mindfulness group as well as the relaxation group were statistically

significant (p<.001), and there were more 7th graders in the non-treatment group. By special need education, there was a significant difference between mindfulness and relaxation group, and more students took part in special needs education in the mindfulness group. Directions of the differences (with-in group percentages) are presented in Table 4.

The SDQ -data gathered at baseline (T1), post-intervention (T2), and six-month follow-up (T3) are displayed in Table 5. There were no statistically significant baseline differences on levels of SDQ-scales between groups rated by students (Wilk's λ=.95, F(10,5456)=0.90, p=.53, η^2=.002) or their parents (Wilk's λ=.95, F(10,4202)=1.57, p=.11, η^2=.004). Overall, the self-rated emotional and behavioural problems were on a higher level compared to difficulties rated by parents.

Table 5. Means and (standard deviations) of SDQ-outcome variables at baseline (T1), post-intervention (T2), and after six-month follow-up (T3).

SDQ-variable		Student			Parent		
		Mindfulness	Relaxation	Non-treatment	Mindfulness	Relaxation	Non-treatment
Total	T1	10.40 (5.44)	10.20 (5.45)	10.32 (5.54)	5.67 (4.41)	5.88 (4.39)	5.79 (4.50)
	T2	10.10 (5.85)	10.40 (6.08)	10.03 (5.96)	4.94 (4.19)	5.26 (4.28)	5.35 (4.18)
	T3	9.81 (5.87)	9.74 (6.11)	9.75 (5.92)	4.84 (4.31)	4.62 (4.07)	4.81 (3.84)
Emotional	T1	2.92 (2.31)	2.89 (2.26)	2.92 (2.29)	1.22 (1.60)	1.25 (1.54)	1.25 (1.54)
	T2	2.74 (2.30)	2.85 (2.29)	2.68 (2.28)	0.97 (1.49)	1.03 (1.50)	0.98 (1.38)
	T3	2.66 (2.29)	2.71 (2.32)	2.70 (2.27)	0.95 (1.45)	0.96 (1.44)	0.87 (1.34)
Conduct	T1	2.09 (1.65)	2.03 (1.55)	2.08 (1.60)	1.12 (1.28)	1.19 (1.34)	1.22 (1.29)
	T2	2.04 (1.69)	2.16 (1.79)	2.05 (1.65)	0.96 (1.16)	1.12 (1.31)	1.21 (1.30)
	T3	1.97 (1.72)	1.94 (1.76)	1.94 (1.65)	0.94 (1.23)	0.97 (1.25)	1.00 (1.19)
Hyperactivity	T1	3.45 (2.16)	3.34 (2.14)	3.29 (2.13)	1.71 (1.82)	1.75 (1.77)	1.53 (1.77)
	T2	3.31 (2.13)	3.25 (2.13)	3.25 (2.14)	1.45 (1.70)	1.56 (1.73)	1.40 (1.47)
	T3	3.15 (2.04)	3.05 (2.19)	3.13 (2.25)	1.39 (1.73)	1.32 (1.64)	1.31 (1.58)
Peer	T1	1.95 (1.70)	1.95 (1.73)	2.07 (1.92)	1.62 (1.71)	1.70 (1.73)	1.79 (1.69)
	T2	2.01 (1.75)	2.14 (1.84)	2.04 (1.90)	1.56 (1.64)	1.56 (1.65)	1.75 (1.80)
	T3	2.03 (1.85)	2.05 (1.88)	1.97 (1.85)	1.55 (1.76)	1.37 (1.50)	1.62 (1.60)
Prosocial	T1	7.37 (1.81)	7.51 (1.85)	7.33 (1.85)	7.54 (1.91)	7.64 (1.84)	7.42 (1.78)
	T2	7.55 (1.96)	7.45 (2.01)	7.43 (1.88)	7.70 (1.93)	7.68 (1.89)	7.42 (1.84)
	T3	7.57 (2.00)	7.65 (1.96)	7.53 (1.92)	7.68 (1.88)	7.90 (1.82)	7.57 (1.86)

Note. T1= baseline; T2 = post-intervention; T3 = follow-up.

3.2. Intervention effects

Linear mixed effects modelling (LMM) was used to compare differences between groups in the change from baseline to post-intervention and follow-up in the SDQ-scales. Based on the

information criteria (BIC), first-order autoregressive covariance matrix was used on all the analyses. The overall results are displayed in Table 6. The model revealed significant main-effects of *time* for all outcome variables, but no significant main effects of *group* were found across the twelve SDQ-outcome scales. One significant *group x time* interaction was found on self-rated prosocial behaviour (F(4,4807.51)=2.68, p=.03). Pairwise comparisons, however, did not reveal statistically significant differences on this SDQ-scale between groups (p>.05) at post-intervention or follow-up.

Table 6. Linear mixed model analyses between the groups.

	Group		Time		Group x Time	
SDQ variable	F	df	F	df	F	df
Student						
Total	0.12	2,178.34	4.67**	2,4694.42	1.37	4,4707.82
Emotional	0.14	2,178.78	6.76**	2,4750.66	0.81	4,4765.74
Conduct	0.31	2,168.13	5.41**	2,4781.72	1.81	4,4798.72
Hyperactivity	0.16	2,177.23	7.09**	2,4730.27	0.30	4,4742.54
Peer	0.53	2,173.36	3.91*	2,4726.46	1.58	4,4740.95
Prosocial	0.16	2,179.53	5.02**	2,4792.07	2.68*	4,4807.51
Parent						
Total	0.50	2,141.87	36.98***	2,2953.18	2.17+	4,2960.52
Emotional	0.15	2,164.52	31.89***	2,3032.59	0.26	4,3043.61
Conduct	1.53	2,171.73	10.54***	2,3002.18	1.32	4,3013.06
Hyperactivity	0.84	2,145.21	17.01***	2,2934.55	1.86	4,2942.98
Peer	2.19	2,125.30	6.33**	2,3022.57	1.57	4,3031.50
Prosocial	1.59	2,176.09	3.93*	2,3049.48	1.71	4,3060.70

Note. Controlled: gender and grade, *p≤ .05, ** p≤.01, ***p≤.001, + p ≤.10.

The pairwise comparisons by groups are fully displayed in Table 7. The results did not reveal statistically significant differences (p>.05) in any SDQ -outcome variables between the three groups at post-intervention or follow-up. There was, however, a trend towards parent in the mindfulness group reporting fewer conduct problems when compared with the non-treatment group at post-intervention (mean difference= -.21, p=.09), but the difference evened out during the follow-up period. Likewise, at follow-up, there was a marginally significant difference between relaxation group and mindfulness group on parent-rated prosocial behaviour (mean difference= -.26, p=.08), and between relaxation group and non-treatment group on parent-rated peer problems (mean

difference= -.29, p=.10), indicating some probable positive effects on students' social well-being in the relaxation group. Overall results are demonstrated in Figures 2 and 3.

Table 7. Pairwise comparisons between the groups at post-intervention (T2) and six-month follow-up (T3).

		Student		Parent	
		T2	T3	T2	T3
SDQ variable		Mean difference (95% CI)	Mean difference (95% CI)	Mean difference (95% CI)	Mean difference (95% CI)
Total	MI v RC	-0.35 (-1.11-0.40)	-0.11 (-0.89-0.67)	-0.28 (-0.83-0.26)	0.21 (-0.39-0.81)
	MI v N-T	-0.06 (-1.19-1.08)	-0.05 (-1.21-1.11)	-0.49 (-1.28-0.29)	-0.06 (-0.88-0.77)
	RC v N-T	0.29 (-0.84-1.43)	0.05 (-1.10-1.21)	-0.21 (-1.00-0.57)	-0.27 (-1.08-0.54)
Emotional	MI v RC	-0.09 (-0.35-0.17)	-0.06 (-0.33-0.22)	-0.03 (-0.23-0.16)	0.03 (-0.20-0.25)
	MI v N-T	-0.03 (-0.43-0.36)	-0.11 (-0.51-0.30)	-0.07 (-0.35-0.21)	0.00 (-0.30-0.30)
	RC v N-T	0.06 (-0.34-0.46)	-0.05 (-0.45-0.36)	-0.04 (-0.31-0.24)	-0.02 (-0.31-0.27)
Conduct	MI v RC	-0.16 (-0.37-0.06)	-0.02 (-0.24-0.20)	-0.13 (-0.30-0.03)	-0.04 (-0.23-0.15)
	MI v N-T	-0.04 (-0.36-0.27)	0.03 (-0.30-0.36)	-0.21 (-0.45-0.02) +	-0.05 (-0.30-0.20)
	RC v N-T	0.11 (-0.21-0.43)	0.05 (-0.27-0.38)	-0.08 (-0.31-0.15)	-0.01 (-0.25-0.24)
Hyperactivity	MI v RC	0.03 (-0.23-0.28)	0.07 (-0.19-0.34)	-0.06 (-0.27-0.16)	0.09 (-0.15-0.33)
	MI v N-T	0.05 (-0.33-0.44)	0.01 (-0.39-0.40)	0.05 (-0.25-0.35)	0.15 (-0.17-0.47)
	RC v N-T	0.03 (-0.36-0.42)	-0.07 (-0.46-0.33)	0.10 (-0.20-0.41)	0.06 (-0.26-0.37)
Peer	MI v RC	-0.13 (-0.36-0.10)	-0.09 (-0.33-0.15)	-0.06 (-0.28-0.16)	0.13 (-0.12-0.38)
	MI v N-T	-0.05 (-0.40-0.30)	0.00 (-0.35-0.36)	-0.25 (-0.56-0.06)	-0.16 (-0.49-0.17)
	RC v N-T	0.08 (-0.27-0.43)	0.09 (-0.26-0.45)	-0.19 (-0.50-0.13)	-0.29 (-0.61-0.04) +
Prosocial	MI v RC	0.13 (-0.10-0.36)	-0.01 (-0.25-0.23)	-0.01 (-0.25-0.24)	-0.26 (-0.53-9.02) +
	MI v N-T	0.09 (-0.25-0.44)	0.06 (-0.30-0.41)	0.18 (-0.17-0.52)	-0.01 (-0.38-0.36)
	RC v N-T	-0.04 (-0.39-0.31)	0.06 (-0.29-0.42)	0.18 (-0.17-0.53)	-0.25 (-0.11-0.61)

Note. MI = Mindfulness group, RC = Relaxation control group, N-T = Non-treatment group; +p≤.10

The pairwise comparisons by time within each group are presented in Table 8. In the mindfulness group, students' self-rated emotional symptoms (T1 v T2, p<.01; T1 v T3, p<.01) and hyperactivity problems (T1 v T3, p<.01) significantly decreased and prosocial behaviour increased (T1 v T2, <.01; T1 v T3, p<.05). On the contrary, there were statistically significant increases in peer problems at post-intervention (T1 v T2, p<.05). No changes in total difficulties or conduct problems were found. As rated by parents, there were statistically significant decreases, at post-intervention and follow-up, in students' emotional symptoms (T1 v T2, p<.001; T1 v T3, p<.001), conduct problems (T1 v T2, p<.01; T1 v T3, p<.01), hyperactivity problems (T1 v T2, p<.001; T1 v T3, p<.01), and total difficulties (T1 v T2, p<.001; T1 v T3, p<.001). In turn, changes in peer problems or prosocial behaviour were not detected.

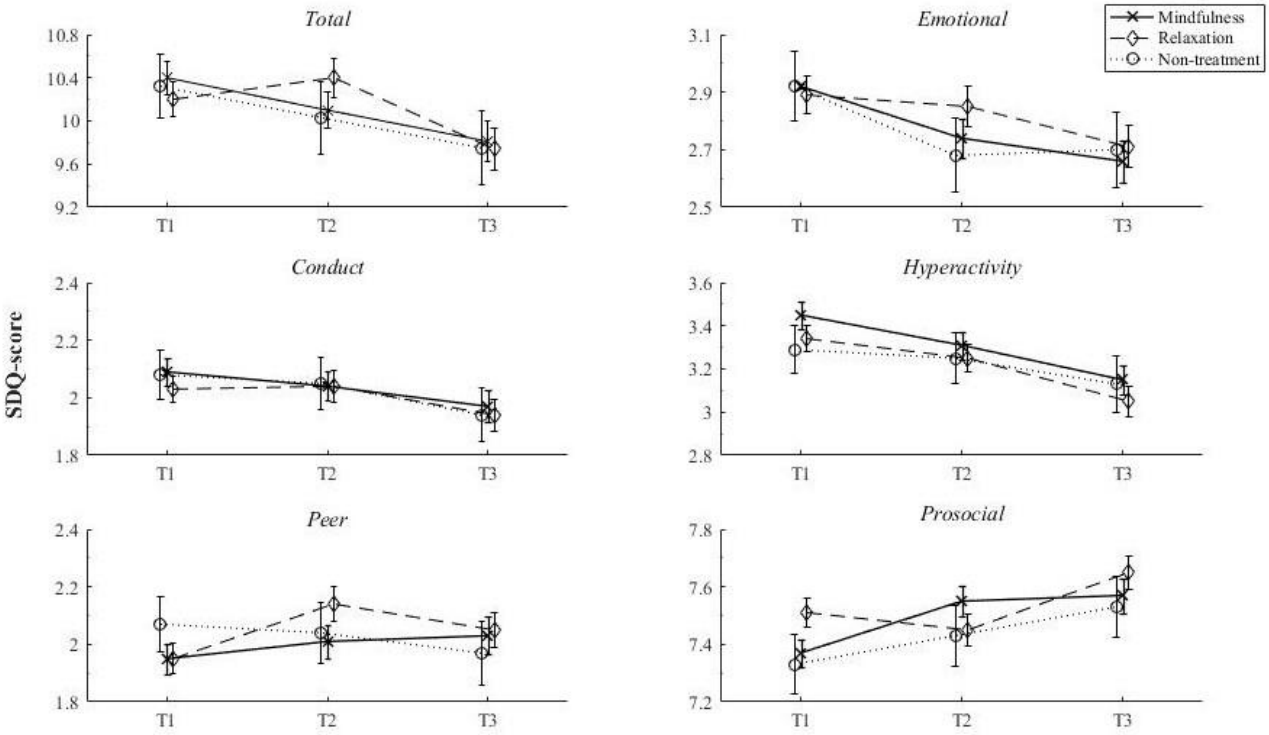

Figure 2. Mean scores and standard errors for SDQ-scales rated by students between groups at baseline (T1), post-intervention (T2), and six-month follow-up (T3).

In the relaxation group, student's self-rated hyperactivity problems significantly decreased (T1 v T3, p<.001; T2 v T3, p<.01), and peer problems, on the contrary, significantly increased (T1 v T2, p<.001; T1 v T3, p<.05). Results for conduct problems were not linear, as the problems increased during the study period and decreased to the baseline level after the follow-up (T1 v T2, p<.01; T2 v T3, p<.001). No changes were detected in total difficulties, emotional symptoms, and prosocial behaviour between baseline and post-intervention or follow-up (T1 v T2, p>.05; T1 v T3, p>.05). The results in the parent-rated SDQ-scales, in turn, revealed positive changes in each subscale, as students' emotional symptoms (T1 v T2, p<.001; T1 v T3, p<.001), conduct problems (T1 v T3, p<.01; T2 v T3, p<.05), hyperactivity problems (T1 v T2, p<.001; T1 v T3, p<.001), peer problems (T1 v T3, p<.001), and total difficulties (T1 v T2, p<.001; T1 v T3, p<.001) significantly decreased and prosocial behaviour increased (T1 v T3, p<.01).

In the non-treatment condition, where participants did not receive any active intervention during the study period, there were statistically significant decreases in parent-rated total difficulties (T1 v T3, <.001; T2 v T3, p<.05), emotional symptoms (T1 v T2, p<.01; T1 v T3, p<.001), and conduct problems (T1 v T3, p<.05). No statistically significant changes were found in other SDQ-outcome variables.

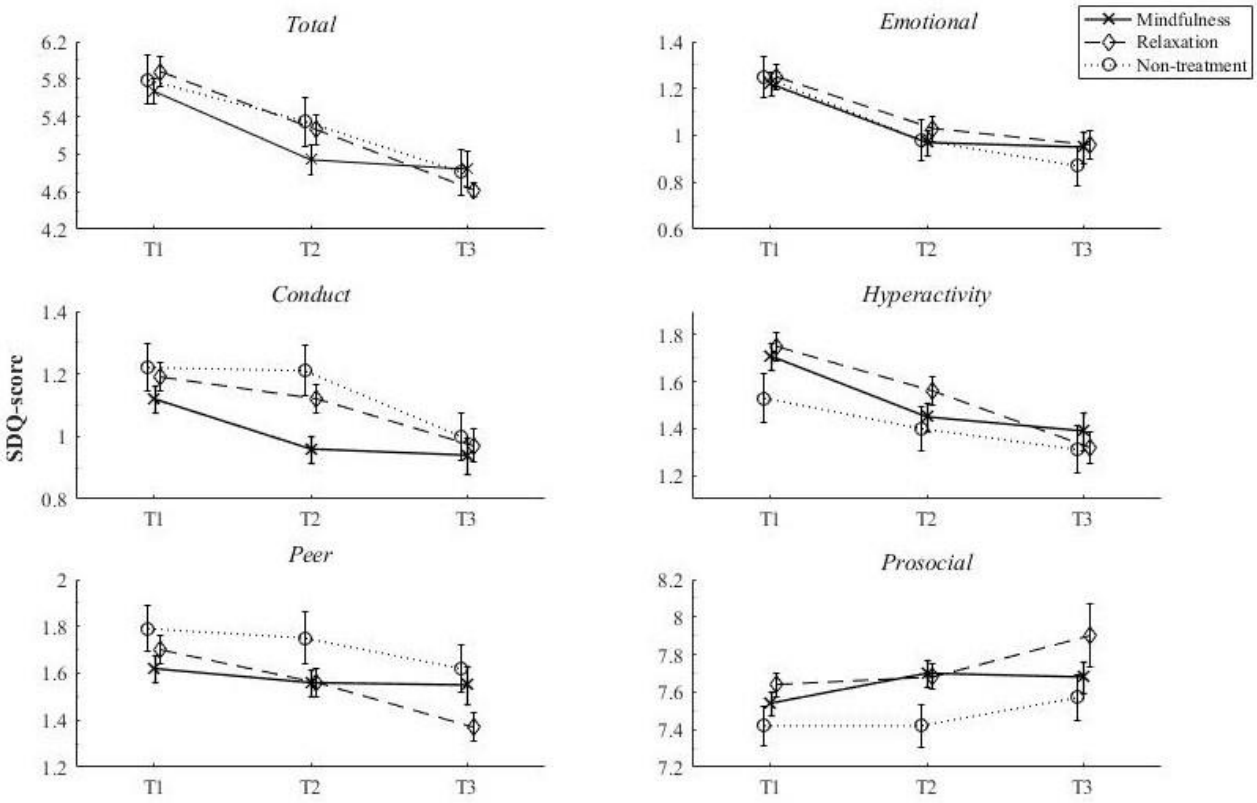

Figure 3. Mean scores and standard errors for SDQ-scales by groups rated by parents at baseline (T1), post-intervention (T2), and six-month follow-up (T3).

Table 8. The pairwise comparisons by time within the mindfulness group, the relaxation group, and the non-treatment group.

SDQ variable			Mindfulness	Relaxation	Non-treatment
			Mean difference (95% CI)	Mean difference (95% CI)	Mean difference (95% CI)
Student					
	Total	T1 v T2	0.14 (-0.19-0.48)	-0.25 (-0.59-0.10)	0.24 (-0.39-0.86)
		TI v T3	0.40 (-0.05-0.84) +	0.25 (-0.19-0.69)	0.50 (-0.31-1.30)
		T2 v T3	0.25 (-0.11-0.62)	0.50 (0.14-0.86)**	0.26 (-0.40-0.92)
	Emotional	T1 v T2	0.18 (0.04-0.32)**	0.06 (-0.09-0.20)	0.21 (-0.05-0.47)
		TI v T3	0.24 (0.05-0.42)**	0.14 (-0.04-0.33)	0.19 (-0.14-0.53)
		T2 v T3	0.06 (-0.10-0.21)	0.09 (-0.06-0.24)	-0.02 (-0.29-0.26)
	Conduct	T1 v T2	0.00 (-0.11-0.12)	-0.15 (-0.26-(-0.03)**	0.00 (-0.21-0.21)
		TI v T3	0.06 (-0.08-0.21)	0.05 (-0.10-0.19)	0.14 (-0.13-0.40)
		T2 v T3	0.06 (-0.07-0.18)	0.19 (0.07-0.32)***	0.13 (-0.09-0.36)
	Hyperactivity	T1 v T2	0.09 (-0.04-0.21)	0.06 (-0.06-0.18)	0.03 (-0.20-0.26)
		TI v T3	0.22 (0-05-0.38)**	0.24 (0.08-0.40)***	0.11 (-0.18-0.41)
		T2 v T3	0.13 (0.00-0.26) +	0.18 (0.05-0.31)**	0.08 (-0.16-0.32)
	Peer	T1 v T2	-0.12 (-0.24-(-0.01)*	-0.21 (-0.33-(-0.10)***	0.02 (-0.20-0.23)
		TI v T3	-0.12 (-0.27-0.03)	-0.17 (-0.32-(-0.02)*	0.08 (-0.19-0.35)
		T2 v T3	0.00 (-0.12-0.13)	0.05 (-0.08-0.17)	0.06 (-0.17-0.29)
	Prosocial	T1 v T2	-0.15 (-0.28-(-0.03)**	0.06 (-0.06-0.19)	-0.13 (-0.35-0.10)
		TI v T3	-0.18 (-0.34-(-0.02)*	-0.11 (-0.26-0.05)	-0.19 (-0.48-0.09)
		T2 v T3	-0.03 (-0.16-0.10)	-0.17 (-0.30-(-0.04)**	-0.07 (-0.30-0.17)
Parent					
	Total	T1 v T2	0.58 (0.33-0.83)***	0.59 (0.32-0.85)***	0.39 (-0.04-0.82) +
		TI v T3	0.66 (0.28-1.03)***	1.15 (0.79-1.51)***	0.90 (0.33-1.48)***
		T2 v T3	0.07 (-0.25-0.40)	0.57 (0.27-0.86)***	0.51 (0.05-0.97)*
	Emotional	T1 v T2	0.25 (0.13-0.36)***	0.23 (0.12-0.33)***	0.25 (0.07-0.44)**
		TI v T3	0.33 (0.18-0.49)***	0.26 (0.10-0.41)***	0.35 (0.12-0.59)***
		T2 v T3	0.09 (-0.04-0.21)	0.03 (-0.11-0.17)	0.10 (-0.10-0.30)
	Conduct	T1 v T2	0.11 (0.02-0.20)**	0.05 (-0.04-0.15)	0.00 (-0.15-0.16)
		TI v T3	0.14 (0.01-0.27)**	0.18 (0.05-0.30)**	0.20 (0.00-0.40)*
		T2 v T3	0.03 (-0.09-0.15)	0.12 (0.02-0.23)*	0.20 (0.03-0.37)*
	Hyperactivity	T1 v T2	0.17 (0.07-0.28)***	0.19 (0.08-0.30)***	0.03 (-0.15-0.21)
		TI v T3	0.22 (0.07-0.38)**	0.38 (0.23-0.53)***	0.18 (-0.06-0.42)
		T2 v T3	0.05 (-0.09-0.19)	0.20 (0.07-0.32)***	0.15 (-0.05-0.34)
	Peer	T1 v T2	0.08 (-0.03-0.19)	0.09 (-0.02-0.21)	0.11 (-0.08-0.39)
		TI v T3	0.05 (-0.11-0.22)	0.26 (0.10-0.42)***	0.17 (-0.08-0.42)
		T2 v T3	-0.03 (-0.17-0.12)	0.17 (0.04-0.29)**	0.07 (-0.14-0.27)
	Prosocial	T1 v T2	-0.10 (-0.24-0.04)	-0.03 (-0.17-0.11)	-0.02 (-0.26-0.21)
		TI v T3	-0.06 (-0.26-0.14)	-0.24 (-0.43-(-0.05))**	-0.17 (-0.46-0.13)
		T2 v T3	0.04 (-0.14-0.22)	-0.21 (-0.37-(-0.06))**	-0.14 (-0.46-0.13)

Note. ***p ≤.001, **p≤.01,*p≤.05, +p≤.10

4. Discussion

Adolescence is an intensive period of development when psychological well-being of young people should be supported. Programs of mindfulness training are promising interventions to promote and maintain students' mental well-being and psychological functioning. MBIs are already used increasingly with students in schools, but there are only a few high-quality studies on the efficacy. The present study provides a large cluster randomized controlled trial with aim to investigate the effects of mindfulness training on adolescents' psychological well-being in secondary school. Despite the promising previous evidence, the study didn't find any differences in the change of psychological well-being from baseline to post-intervention or six-month follow-up between the mindfulness group, the relaxation group, and the group that followed usual school curriculum. During the mindfulness program, however, students' self-rated emotional symptoms and hyperactivity decreased, and prosocial behaviour increased. Findings in the parent-rated results paralleled these results and there were decreases in students' conduct problems, emotional symptoms, and hyperactivity. Improvements in peer problems were not found rated by either informant.

4.1. Findings within the mindfulness group

The goal of the mindfulness program .b Curriculum is to support and improve adolescents' mental well-being and psychological function by developing attention control, behavioural and emotional regulation, and overall skills to work with everyday stressors (Kuyken et al., 2013; Volanen et al., 2016). Thus, as adolescence is a developmentally sensitive life period, mindfulness training integrated into education may offer a way to teach how to deal with new stressors and emotionally hard situations, and how to pay attention and focus on the present moment. This study provides evidence that training may impact on these aspects of adolescents' psychological functions, although significant differences between the groups were not found. This is in line with earlier findings that suggest mindfulness training to have equally large improvements in adolescents' emotional, behavioural, and attention problems as active control programs, but no differences between conditions (Britton et al., 2014).

The main findings of this study inside the mindfulness group parallel also other previous findings that have found mindfulness training to be effective to decrease attention problems (e.g. Black & Fernando, 2014; Napoli, Krech & Holley, 2005; Zylowska et al., 2008), emotional symptoms (Raes

et al., 2014; Kuyken et al., 2013), problem behaviour (Black & Fernando, 2014; Singh et al., 2007), and to enhance prosocial behaviour (Schonert-Reichl et al., 2015). It may be the case that an increased training of awareness and kindness toward inner experiences (emotion, body sensation, thoughts), as part of a mindfulness program, may affect adolescent's brain and nervous system and lead to greater attention control, self-regulation, and empathy towards others, and therefore result in improved psychological well-being and prosocial behaviour (Maloney et al., 2016). On the other hand, mindfulness programs may increase prosocial behaviour due to training of kindness as a part of a group program (Schonert-Reichl et al., 2015). As there were some differences between self- and parent-rated results and no differences between groups, more research is still needed on the effectiveness of MBIs in schools as well as more insight into the effective components leading to specific outcomes to recognize mechanisms behind possible well-being improvements.

4.2. Findings between the groups

The study did not find any differences between the three groups in the change of psychological well-being from baseline to post-intervention or follow-up. The results are similar to some previous school-based controlled studies that also did not find differences between mindfulness and control group(s) on student' psychological well-being (Britton et al., 2014; Huppert & Johnson, 2010; Johnson et al., 2016; Johnson et al., 2017). However, findings are contrary to my hypothesis that was based on the earlier promising studies that show effects of MBIs in secondary schools, compared to control conditions (e.g. Atkinson & Wade, 2015; Kuyken et al., 2013; Raes et al., 2014; Sibinga et al., 2016).

No differences found between the mindfulness group and the relaxation group may result from the reason that both are active-interventions with the aim to support and enhance students' psychological and physical well-being. For instance, previous findings, with older students (mean age: 25), suggest that both mindfulness and relaxation training can similarly reduce distress although mindfulness may have unique effects in reducing rumination and depressed mood (Jain et al., 2007). However, why there weren't differences between the mindfulness group and the non-treatment group, should be speculated. The results showed that even among non-treated students observed psychological difficulties decreased.

Firstly, there is always a chance for potential floor-effects of measures. In a low-risk population, well-being changes are typically small as baseline scores are already at low-level. This study used the short screening instrument to measure adolescents' psychological well-being changes, and

potential floor effects may have impacted on the outcomes. However, when comparing the baseline SDQ total difficulties mean scores (Table 5) to the mean scores of Finnish population study (Koskelainen, Sourander, & Kaljonen, 2000), both self- and parent-rated scores were higher in this study. Also, 17 % (parent-rated 7 %) of students had some psychological difficulties before the intervention using standard diagnostic criteria for the SDQ (Goodman, 2001), which is a notable part of the sample. As compared to the previous school-based pilot study by Joyce et al. (2010), there was a significant reduction in students' psychological difficulties measured by SDQ, also with them who scored at "normal" -level at pre-program. In this study the psychological difficulties decreased similarly inside the mindfulness group, but since the difficulties decreased in all three conditions, no between-group effects were detected. Considering that the mean scores in this study were higher than in the Finnish population study (Koskelainen, Sourander, & Kaljonen, 2000), the fact that many students had notable difficulties to be improved, and the previous findings by Joyce et al. (2010), it is reasonable to assume that the floor-effects do not completely explain the study findings.

The lack of significant well-being effects between the mindfulness group and the non-treatment group may have several other explanations, as adolescents' age, the program content, and facilitators may have impacted on the effectiveness (Carsley, Khoury & Heath, 2018). First possible explanation is the age of the participants. Adolescence is a developmentally rapid period when there is an extensive plasticity in adolescents' brains and in related psychosocial and cognitive systems (Berger, 2003, p.400-403; Giedd, 2008; Roeser & Pinela, 2014). Neurocognitive differences between individuals may impact on response to mindfulness training (Roeser & Pinela, 2014), and in the late adolescence, training may have greater effect on individuals' mental well-being, being also helpful more immediately (Carsley, Khoury & Heath, 2018). In this study as well as in study by Johnson et al. (2017), participants were early-adolescents which may explain the null-results of both studies, when compared with many other RCTs whose participants have been a few years older (Atkinson & Wade, 2015; Kuyken et al., 2013, Raes et al., 2014). Based on these findings, mindfulness training may be more useful when maturation goes forward and executive functions and cognitive systems develop further (Carsley, Khoury & Heath, 2018).

Alongside with neurocognitive maturation, in the late adolescence individuals can be more responsive to mindfulness training due to psychosocial development. For instance, it has been proposed that the skills of mindfulness become more beneficial for well-being in the late adolescence as it is a developmental period when young people face more challenges and stressful situations compared to early adolescence (Johnson et al., 2017). Physical and psychosocial changes,

such as puberty and identity issues, can be very confusing for adolescents, and training of acceptance, awareness, and relaxation of a body can offer possible support for development (Rechtschaffen, 2014, p. 132). However, because of the lack of long-term studies on mindfulness programs, there is a lack of knowledge on how mindfulness training impacts young people when they are maturing (Felver & Jennings, 2016). There are preliminary results that mindfulness practices are useful tools already in elementary school for children's mental well-being and psychological functioning (reviews: Felver et al., 2016; Meiklejohn et al., 2012), for example by reducing anxiety, depression, inattention, problem behaviour, and developing overall executive functions, attention control, and prosocial behaviour (Black & Fernando, 2014; Flook et al., 2010; Liehr & Diaz, 2010; Napoli, Krech & Holley, 2005; Schonert-Reichl et al., 2015).

Secondly, too small amount of mindfulness training can also reflect the lack of significant group differences between mindfulness group and non-treatment group. In some previous studies, students who engaged in more frequent mindfulness training reported better well-being improvements (e.g. Biegel et al., 2009; Huppert & Johnson, 2010; Kuyken et al., 2013). However, there is also contrary evidence that home practice is not associated with positive well-being outcomes among adolescents (Johnson et al., 2017). Because adolescents may not be as motivated as adults to do home practice alone, instead of encouraging them to practice more in free time, the effects may be stronger if training time especially in school is increased. In this study, adolescents received only one 45-min long mindfulness session per week which may be too small amount for significant well-being improvements (see: Huppert & Johnson, 2010), especially when compared with adults' interventions which typically include weekly 2-hour group sessions and day-to-day home practices (Baer, 2003). Even though this study did not investigate how training time is associated to the effectiveness, it is possible that mindfulness training would be more effective if training time in school or at home is increased.

In addition to the dose of mindfulness training, the type of the intervention may have had an impact on the effectiveness (Carsley, Khoury & Heath, 2018). As the .b Curriculum is the modification of the adults' MBSR program, it is possible that further modifications are still needed to ensure that the program is adequate for adolescents in secondary school. For instance, it has been suggested that the mechanism of mindfulness between adults and adolescents may differ due to neurocognitive development, so content of a program should not be just a modification of adult's interventions (Johnson et al., 2016). Currently, there is a huge amount of different MBIs for children and adolescents (Burke, 2010; Meiklejohn et al., 2012), and more research is still needed to investigate if there are differences between different programs. Preliminarily, programs with

various mindfulness practices or yoga-based activities have revealed significant effects both within- and between-group analyses at post-intervention and follow-up, but in turn, existing or pre-designed MBIs have shown only a small between group effect at post-intervention (Carsley, Khoury & Heath, 2018). Thus, what is the best way to teach mindfulness skills to Finnish adolescents, should still be considered further.

Along with the age and the content of the program, also facilitators of the curriculum might have impacted on the study outcomes. This study used 9 educated outsider mindfulness facilitators, but according to the recent evidence, programs delivered by trained classroom teachers may show more effects on mental health (Carsley, Khoury & Heath, 2018). Instead of outsider facilitators, the regular teachers are more familiar with the students which may lead to more positive outcomes. For instance, adolescents may trust more in familiar teachers which may be an important factor to learn the skills of mindfulness and to achieve positive behavioural changes (Johnson et al., 2016). Teachers can also motivate students for home practices and they can implement short trainings during normal lessons. It has been suggested that skills of mindfulness take time to be learnt, and thus well-being benefits may show over a longer timespan (Atkinson & Wade, 2015). When teachers are more involved, it is more likely that they will continue trainings with their students, which may predict positive consequences over time (Britton et al., 2014, Carsley, Khoury & Heath, 2018). Additional benefit for using classroom teachers may be a long education and an experience of teaching and working with adolescents, given the sensitivity of the developmental period and specific needs of adolescents. On the other hand, regular teacher may not be as familiar with mindfulness training, or how it can be practically implemented into classroom. In the future, however, it is important to expand the delivery of MBIs to teachers or other school personnel to make it possible to implement mindfulness practices as a part of school curriculum more permanently (Atkinson & Wade, 2015).

4.3. Strengths and limitations

This study had several strengths including the cluster randomized controlled design, the large sample size and the long follow-up. The sample size of the research project was by far the largest, as compared with other large school-based studies of mindfulness training (Atkinson & Wade, 2015; Kuyken et al., 2013; Raes et al., 2014, Johnson et al., 2017; Sibinga et al., 2016). Therefore, study provided valuable data regarding the effects of mindfulness training on psychological well-being of adolescents. Testing the mindfulness curriculum and the relaxation program alongside

each other offered also new comparative information on both interventions. Also, the analyses were one strength of this study since both school-class-level and individual-level variations were accounted for, especially as randomization was done at this level. The 6-month follow-up offered a good opportunity to investigate the maintenance of the intervention effects. The mindfulness program was standardized, which was a strength that makes the results comparable to many previous studies (e.g. Huppert & Johnson, 2010; Johnson et al., 2016; Johnson et al., 2017; Kuyken et al., 2013). The program was conducted with many educated facilitators with the intention that each lesson would differ minimally between the classes (Volanen et al., 2016). The use of many instructors may have limited the consistency, but the generalizability was improved. Finally, although the study leant only on one subjective measure of psychological well-being, adding the observer rated measure besides the self-report minimized a responding bias.

The results should be also interpreted with some limitations. First, the rate of missing information limited the generalizability of findings at some level. Even so, as the sample size remained large and LMM-analyses used all the available data, missing information likely didn't limit the power to detect statistical significance and explain the null-results between groups. Second, there were significantly fewer participants in the non-treatment group than in the other conditions which may have limited the ability to detect differences between groups. Third, the research project was conducted only at schools in Southern Finland which limited the generalizability to the full country. In Finland, however, the overall school-system is relatively homogenous, and therefore the results can be expected to generalize well to the Finnish population (Volanen et al., 2016). Lastly, and most notably, the SDQ is only a short screening instrument for emotional and behavioural problems, and it may have not been sensitive enough for small mental well-being changes, especially to detect between group differences. Also, internal consistencies were at poor level (0.52-0.60) for SDQ conduct problem -subscales which weakened the reliability of the results to some extent.

4.4. Further research

In future studies, it would be important to compare MBIs across childhood and adolescence to find the optimal age for specific mindfulness practices, and to investigate how effects on socio-emotional well-being, behaviour, and attention differ by development. Thus, longitudinal research is desired to understand how effects differ by development. Also, longer programs, such as year(s) long mindfulness interventions, will give more information about how much mindfulness training impact on students' self-regulation, attention, stress resilience, and overall psychological well-

being, and what are the benefits of continuous training up to adulthood (Meiklejohn et al., 2012). Future research could also investigate, do multiple sessions impact on well-being effects. For example, it would be interesting to test how short daily mindfulness trainings, as a part of educational curriculum, impact on adolescents' emotional well-being and classroom behaviour.

In the future, it is also vital to think about the content of this universal mindfulness program and its suitability exactly to Finnish schools and their students. Today, there is a huge amount of different MBIs for children and adolescents (Meiklejohn et al., 2012), so further investigations can concentrate on finding the most optimal content for the program across specific applications and single trainings. Trainings should be suitable for adolescents' psychological development (Carsley, Khoury & Heath, 2018) and the future focus has been recommended to be, especially, on practical exercises to help mindfulness be generalized in everyday life (Johnson et al., 2016). When modifying contents of MBIs to correspond adolescents' developmental needs, it would be essential to explore how mindfulness training impacts on neurocognitive level, and how developmental neurocognitive changes are related to mindfulness training (Kaunhoven & Dorjee, 2017). Currently, it has been suggested that mindfulness training could potentially modify both top-down and bottom-up processes of self-regulation, such as endogenous attention orienting and automatic processes of stimulus driven attention and mind wandering, and therefore be an adaptive self-regulation strategy (Kaunhoven & Dorjee, 2017).

Overall, future research should provide more information about the active ingredients of MBIs with adolescents as well as underlying mechanisms for potential well-being changes. Therefore, studies should use different evaluation methods (alongside with RCTs) and multiple measurement methods including more objective measures and structural interview-based methods for psychological difficulties, separately for emotional, behavioural, inattention, and peer problems. It should also focus even more on students' positive resources, such as how mindfulness training impacts on social skills, prosocial behaviour, positive emotions, and emotional intelligence in schools (e.g. Joyce et al., 2010). Lastly, the follow-up should extend even more to regulate better potential prevention effects of MBIs.

4.5. Conclusion

In conclusion, the research project Healthy Learning Mind is, so far, the largest randomized controlled trial to examine the effects of mindfulness training on adolescents' psychological well-being, stress resilience, and learning in school settings. As a part of the project, this thesis provides

important findings about the effects on psychological well-being of adolescents and new knowledge about the helpfulness of mindfulness training as compared with the relaxation program. The study did not find any differences between the three groups, and clearly more research is needed to explore what are unique effects of mindfulness training on adolescents' psychological well-being, as compared with other possible health programs. While there weren't any differences between the conditions, some promising results were found after all as students within the mindfulness group showed reduced emotional symptoms, hyperactivity, behavioural problems, and increased prosocial behaviour that are parallel with many previous studies. Thus, mindfulness training may have some potential benefits for students' psychological well-being, but more research is necessary.

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Appendix

1. Items and scales for the self-rated and (parent-rated) SDQs

Emotional symptoms scale

Item 3: I get a lot of headaches, stomach-aches or sickness (Often complains of headaches…)

Item 8: I worry a lot (Many worries, often seems worried)

Item 13: I am often unhappy, down-hearted or tearful (Often unhappy, downhearted…)

Item 16: I am nervous in new situations. I easily lose confidence (Nervous or clingy in new situations…)

Item 24: I have many fears, I am easily scared (Many fears, easily scared)

Conduct problems scale

Item 5: I get very angry and often lose my temper (Often has temper tantrums or hot tempers)

Item 7: I usually do as I am told (Generally obedient, usually does what adults request)

Item 12: I fight a lot. I can make other people do what I want (Often fights with other children or bullies them)

Item 18: I am often accused of lying or cheating (Often lies or cheats)

Item 22: I take things that are not mine from home, school or elsewhere (Steals from home…)

Hyperactivity scale

Item 2: I am restless, I cannot stay still for long (Restless, overactive…)

Item 10: I am constantly fidgeting or squirming (Constantly fidgeting or squirming)

Item 15: I am easily distracted, I find it difficult to concentrate (Easily distracted, concentration wanders)

Item 21: I think before I do things (Thinks things out before acting)

Item 25: I finish the work I'm doing. My attention is good (Sees tasks through to the end, good attention span)

Peer problems scale

Item 6: I am usually on my own. I generally play alone or keep to myself (Rather solitary, tends to play alone)

Item 11: I have one good friend or more (Has at least one good friend)

Item 14: Other people my age generally like me (Generally liked by other children)

Item 19: Other children or young people pick on me or bully me (Picked on or bullied by other children)
Item 23: I get on better with adults than with people my own age (Gets on better with adults than with other children)

Prosocial scale
Item 1: I try to be nice to other people. I care about their feelings (Considerate of other people's feelings)
Item 4: I usually share with others (food, games, pens etc.) (Shares readily with other children…)
Item 9: I am helpful if someone is hurt, upset or feeling ill (Helpful if someone is hurt…)
Item 17: I am kind to younger children (Kind to younger children)
Item 20: I often volunteer to help others (parents, teachers, children) (Often volunteer to help others…)

2. Background variables and difference statistics for parent-rated data

Table 9. Frequencies of background variables for the total sample and by trial arms and the significance of group differences for parent-rated data.

Background variable		Total	Mindfulness	Relaxation	Non-treatment	p_a	p_b	p_c
		n (%)	n (%)	n (%)	n (%)			
Gender						.88	.91	.14
	Girl	1243 (52.4 %)	540 (50.6 %)	529 (54.7 %)	174 (51.2 %)			
	Boy	1131 (47.6 %)	527 (49.4 %)	438 (45.3 %)	166 (48.8 %)			
Grade						.16	<.001	<.001
	6	886 (37.3 %)	421 (39.5 %)	368 (38.0 %)	97 (28.4 %)			
	7	445 (18.7 %)	140 (13.1 %)	160 (16.5 %)	145 (42.5 %)			
	8	1045 (44.0 %)	506 (47.4 %)	440 (45.5 %)	99 (29.0 %)			
Mother tongue						<.001	<.001	<.001
	Finnish	1825 (81.5 %)	810 (79.9 %)	720 (79.2 %)	295 (93.4 %)			
	Swedish	247 (11.0 %)	140 (13.8 %)	106 (11.7 %)	1 (0.3 %)			
	Other	167 (7.5 %)	64 (6.3 %)	83 (9.1 %)	20 (6.3 %)			
Special needs education						<.001	.28	.65
	Yes	123 (5.2 %)	66 (6.2 %)	40 (4.1 %)	17 (5.0 %)			
	No	2253 (94.8 %)	1001 (93.8 %)	928 (95.6 %)	324 (95.0 %)			

Note. Total N = 2376, missing information: gender = 2, mother tongue = 137

p-values obtained from χ2-test: p_a = Mindfulness versus Relaxation,

p_b = Mindfulness versus Non-treatment, p_c = Relaxation versus Non-treatment.